

Rec'd PCT/PTO 1 MAY 2005

10/534 461

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization International Bureau



(43) International Publication Date
1 July 2004 (01.07.2004)

PCT

(10) International Publication Number
WO 2004/055490 A1

(51) International Patent Classification⁷: **G01M 17/02**

(21) International Application Number:
PCT/IT2002/000804

(22) International Filing Date:
18 December 2002 (18.12.2002)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): SECURIT'Y CONTROL S.R.L. [IT/IT]; Sistiana, 21/A, I-34019 Sistiana (TS) (IT).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **VISINTIN, Roberto** [IT/IT]; Via Jacopo Cavalli, 8, I-34129 Trieste (TS) (IT).

(74) Agent: **BOSCHIN, Adriano**; Studio Tecnico S.A.I. S.a.s, Via Imbriani, 2, I-34122 Trieste (IT).

(81) Designated States (national): AE, AG, AL, AU, BA, BB, BG, BR, BZ, CA, CN, CO, CR, CU, CZ, DM, DZ, EC, EE, GD, GE, HR, HU, ID, IL, IN, IS, JP, KP, KR, LC, LK, LR, LT, LV, MA, MG, MN, MX, NO, NZ, OM, PH, PL, RO, RU, SG, SK, TN, TR, TT, UA, VN, YU, ZA.

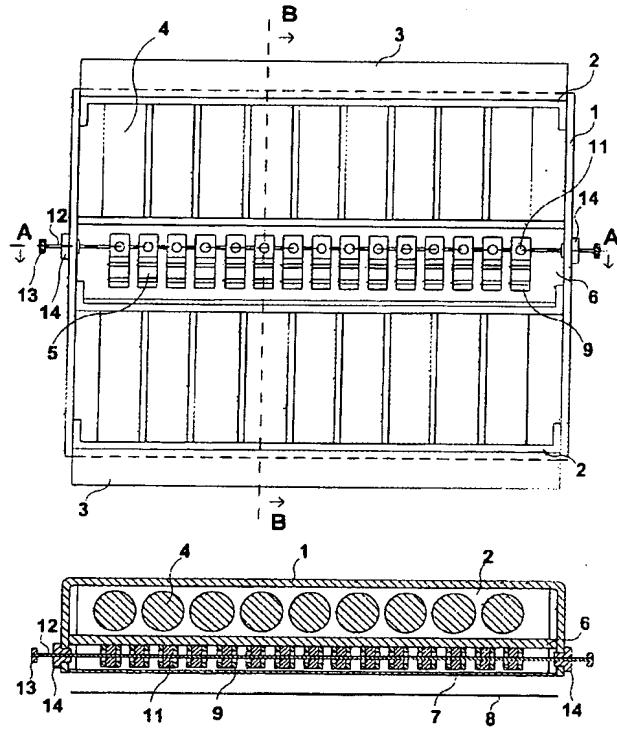
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— as to the identity of the inventor (Rule 4.17(i)) for the following designations AE, AG, AL, AU, BA, BB, BG, BR, BZ, CA, CN, CO, CR, CU, CZ, DM, DZ, EC, EE, GD, GE, HR, HU, ID, IL, IN, IS, JP, KP, KR, LC, LK, LR, LT, LV, MA, MG, MN, MX, NO, NZ, OM, PH, PL, RO, RU, SG, SK, TN, TR, TT, UA, VN, YU, ZA, ARIPO patent (GH, GM, KE, LS,

{Continued on next page}

(54) Title: MAGNETIC-INDUCTIVE DEVICE FOR THE CONTROL OF FERROMAGNETIC RETICLES



(57) Abstract: The device object of this patent is composed of: -one box (1) which is U-shaped in its transversal section; -two guiding plates (2) for the magnets (4); -two L-shaped rolled sections (3), which constitute the magnets (4) pole pieces; -various magnets (4) placed parallelly to the ferromagnetic insert (8) to be tested; each magnet (4) is placed parallel to the ferromagnetic insert (8) sliding direction with respect to the device and vice versa; -various measuring coils (5) placed in a housing (6), which is U-shaped in its transversal section; -a covering plate (7) fixed to box (1) in such a way to occupy the device side facing the insert (8) to be tested; -simple gears permitting to direct, in following times, the coils (5) parallelly to the different angles of the ferromagnetic insert (8) layers.

WO 2004/055490 A1



*MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW). Eurasian patent
(AM, AZ, BY, KG, KZ, MD, RU, TJ, TM). European patent
(AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB,
GR, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR). OAPI patent
(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE,
SN, TD, TG)*

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Magnetic-inductive device for the control of ferromagnetic reticles.

Technical Field

This invention consists in a device that allows a non-destructive testing of the metal inserts made of ferromagnetic material in the form of wires and webs and is therefore particularly suitable for the inspection of tyres before being reconstructed.

Background Art

The metal inserts in ferromagnetic material are used in different applications. They can be used as supporting elements of complex structures or as being part of particular single elements.

For example, the covering of a tyre has an internal insert of steel wires, which are criss-crossed to strengthen the whole structure.

Worn out tyres are covered with a new tread allowing in this way their recycling. The reconstructed tyre achieves, in this way, security levels which can be compared to a new tyre from any point of view. The application of stricts working procedures, from the acquisition and suitability testing of the structure, to very accurate pressure controls of the final product under working conditions, guarantees the high quality of the entire production process.

All wracks directed to reconstruction are in fact previously carefully examined through the utilization of suitable equipment, which verifies the conditions of suitability to reconstruction.

One of the main parameters taken into consideration is the integrity of the metal insert, which is usually tested through x-rays, ultrasounds equipments or through scirografia.

Unfortunately the non-destructive testing of ferromagnetic metal inserts using these appliances is rather expensive.

Summary of the Invention

The main purpose of this invention is to put at the user's disposal a device permitting to identify and signal possible anomalies of the inserts in ferromagnetic material, particularly in those of tyres.

This and other aims are achieved by the device described in this patent.

- 2 -

This device includes a U-shaped box, representing the base and sides of the device itself. A guiding plate for the magnets develops orthogonal to the device along each end of the box. Each guiding plate is fixed to the two opposite sides. A L-shaped rolled section is in turn fixed to both the above mentioned guiding plates.

5 The box contains several magnets, the ends of which are held in the right position by the above mentioned guiding plates. Said rolled sections represent the magnet pole pieces. The box contains also several coils placed in a suitable shell. A covering plate is then fixed to the box, in order to occupy the side of the device facing the metallic insert to be examined. The measuring coils are positioned

10 between the magnets and the metal insert, at the centre of the device. The box is equipped externally with at least a multiple signal power point. The box and the covering plate avoid the contact of the magnets and coils, respectively, with the operator's hands or with the object to be examined.

The inductor consists of pole pieces and permanent magnets made with long-lasting high-stability materials and placed on one or more planes parallel to the ferromagnetic metal insert to be examined. Each magnet is placed parallelly to the sliding direction of the metal insert with respect to the device, object of this patent.

15 When the device slides on the ferromagnetic metal insert, it is correct to say that each magnet is located parallelly to the sliding direction of the device itself on the metal insert to be examined.

20 Each measuring coil is autonomously connected to the multiple signal power point. The coils can also have simple gears, which permit their rotation. It is therefore possible, later on, to direct them following the different angles of the metal layers with respect to the sliding axis of the object to be tested.

25 This device permits a non-destructive testing of the ferromagnetic insert, both on the surface and internal part of an object. The device creates a magnetic field, parallel to that of the insert itself. The position and the possible presence of a damage are identified by one or more coils that are placed in the magnetic field.

30 The signals recorded by the coils are transmitted to a software obtaining a diagram which underlines the presence of defects (their position and extent).

- 3 -

Brief Description of the Drawings

Further characteristics and advantages of this invention will become clearer with a description of some forms of execution of the device, preferred but not exclusive, which are illustrated indicatively, but not limited to, in the enclosed drawings:

- 5 - figure 1 shows a transversal section of a first device according to the invention;
- figure 2 shows a transversal section of a second device according to the invention;
- figure 3 shows a frontal view of a third device according to the invention without covering plate;
- figure 4 shows a transversal section of the device at figure 3, along the plane A-A;
- 10 - figure 5 shows a transversal section of the device at figure 3, along the plane B-B;
- figure 6 shows an enlarged frontal view of the coil and turning stand of the device at figure 3;
- figure 7 shows an enlarged longitudinal view of the same coil and turning stand;
- figure 8 shows a partial view of the device during a tyre testing;
- 15 - figures 9 and 10 show other partial enlarged frontal views of the device at figure 3 with a different positioning of the measuring coils;
- figure 11 shows a partial enlarged frontal view of a device which has different possibilities of coil positioning.

Mode for Carrying Out the Invention

- 20 More precisely the device on subject, in a first preferred embodiment shown in figure 1, is composed of an U-shaped box 1 in transversal section, constituting the device base and sides.

A guiding plate 2 for the magnets develops orthogonal to the device, along each end of box 1. Each guiding plate 2 is fixed to the opposite sides of box 1. Box 1 has

- 25 externally at least one multiple signal power point and a stirrup for its fixing to the machinery. A L-shaped rolled section 3 is in turn fixed to each one of the above mentioned guiding plates 2.

Box 1 contains several magnets 4, the ends of which are held in the right position by holes made in the above mentioned guiding plates 2. Rolled sections 3 are

- 30 magnets' 4 pole pieces.

- 4 -

Box 1 also contains several coils 5, located in a particular shell 6, which is U-shaped in its transversal section. A covering plate 7 is fixed to box 1 in order to occupy the device side facing the ferromagnetic insert 8 under examination. The coils 5 are placed between the magnets 4 and the metal insert 8, at the centre of
5 the device.

Box 1 and covering plate 7 avoid contacts of magnets 4 and coils 5, respectively, with the operator's hands and the object containing the ferromagnetic insert 8.

The inductor is composed of the polar pieces and the permanent magnets 4 made with long-lasting high-stability materials and placed on one or more parallel planes
10 to the ferromagnetic insert 8 to be tested. Each magnet 4 is placed parallel to the sliding direction of the insert 8 with respect to the device object of this patent. When the device slides on the insert 8, it is possible to say that each magnet 4 is placed parallel to the sliding direction of the device on the ferromagnetic insert 8 to be tested.

15 Each coil 5 is autonomously connected to the multiple signal power point. The device object of this patent can have a transversal fitted shape permitting to test inserts 8 having different shaped planes. The device on subject, in a second preferred embodiment shown in figure 2, shows for example a transversal shape with a central plane and two inclined sides. The permanent magnets 4 are placed
20 on three planes, each of them parallel to one plane of the metal ferromagnetic insert 8 to be examined. Coils 5 can be equipped with simple gears permitting their rotation.

In the device on subject, in a third preferred embodiment shown from figure 3 to figure 10, each coil 5 is inserted in its stand 9. This stand has a pin 10 and a
25 screwed roller 11. Each screwed roller 11 is crossed by a screwed bar 12. This bar has on both ends a knob 13 and a bushing 14 sliding along the device side. The screwed bar 12 crosses transversally the entire device. Pins 10 are stuck in particular holes made in the housing base 6 on which the coils 5 are placed.

Pushing with a knob 13 the screwed bar towards the device internal part forces all
30 screwed rollers 11 to move in one direction letting rotate the different housings 9,

- 5 -

which have pins 10 as their fulcrum. In this way it is possible to direct the coils 5 parallelly to one of the angles along which are placed the metal layers of the ferromagnetic insert 8. When pulling the knob 13 towards the device external part, the coils 5 are forced to align parallelly to another angle of the metal layer of the
5 insert 8.

Therefore the ferromagnetic insert 8 can be tested in following moments along all directions in which the metal layers composing the insert itself are directed.
In the device on subject, in a fourth preferred embodiment shown in figure 11 each coil 5 has its own toothed rotating stand 15. This stand has a pin stuck in a hole
10 made in the housing base 6 on which are placed the coils 5. A rack 16 or worm screw crosses the device transversally.

By moving a knob 17, placed at the rack end or at the worm screw end, the toothed turning stands 15 rotate and fit into the rack 16 or into the worm screw itself. In this case too it is possible to test the insert 8 along multiple directions.

CLAIMS

1 - Magnetic-inductive device for the control of ferromagnetic reticles, composed of a U-shaped box (1) in transversal section, which is the base and sides of the device itself, several magnets (4) made with long-lasting high-stability materials, several measuring coils (5), at least one multiple signal power point placed externally to the box (1) and one stirrup for its fixing to the device; said device is characterized by the fact of moreover comprising:

5 - at least two guiding plates (2) for the magnets (4); each guiding plate (2) develops orthogonally to the device along each box (1) end and is fixed to the opposite two sides of the box (1) itself;

10 - two L-shaped rolled sections (3), each developing orthogonally to the device along each box (1) end and both fixed to one of the above mentioned guiding plates (2); said rolled sections (3) constitute the magnets pole pieces (4);

15 - several magnets (4), the ends of which are held in the right position by holes made in the guiding plates (2); the inductor is composed of the polar pieces and the permanent magnets (4), which are placed on one or more parallel planes of the ferromagnetic insert to be tested; each magnet (4) is placed parallel to the ferromagnetic insert (8) sliding direction with respect to the device itself; vice versa, when the device is to slide on the insert (8), it is possible to confirm that each

20 magnet (4) is placed parallel to the device sliding direction on the insert (8);

25 - several coils (5) placed in a housing (6) which is U-shaped in its transversal section; said coils (5) are placed between the magnets (4) and the ferromagnetic insert (8) at the centre of the device; each coil (5) is autonomously connected to the above mentioned multiple signal power point; the signals recorded by the measuring coils (5) are transmitted to a software, producing a diagram that underlines the position and the extent of any damage found in the ferromagnetic insert (8);

30 - a covering plate (7) fixed to box (1) so that it occupies the device side facing the ferromagnetic insert (8) to be examined;

30 - simple gears which enable the coils (5) to rotate parallel, in following times, along

- 7 -

all directions in which the insert (8) metal layers are directed.

2 - Magnetic-inductive device, according to claim 1, characterized by the fact of having a transversal shape suitable to test ferromagnetic inserts (8) shaped along different planes; said permanent magnets (4) are placed on different planes, each 5 one being parallel to a plane of the insert (8) to be examined.

3 - Magnetic-inductive device, according to claim 1, characterized by the fact that said gears, enabling the coils (5) to turn, consist of stands (9), each one housing a coil (5); each stand (9) has a pin (10) and a screwed roller (11); each screwed roller (11) is crossed by a screwed bar (12) having on at least one of its ends a knob (13) 10 and a bushing (14), which slides along the device side; said screwed bar (12) crosses the device transversally; the above referenced pins (10) are stuck in particular holes made in the housing (6) where the coils (5) are placed; by pushing with this knob (13) the connected screwed bar (12) in one direction or in the other, all screwed rollers (11) are forced to move and they make turn the different stands 15 (9), which have the pins (10) as fulcrum.

4 - Magnetic-inductive device, according to claim 1, characterized by the fact that said gears, enabling the coils (5) to turn, are composed of toothed turning stands (15), each one housing a coil (5); each stand (15) has got a pin stuck in a hole drilled in the housing (6) on which the coils (5) are placed; a rack (16) or a worm 20 screw crosses transversally the device; by pushing in one direction or in the other a knob (17) connected to a rack (16) or a worm screw, all toothed turning stands (15) are forced to rotate on their own pins.

1/4

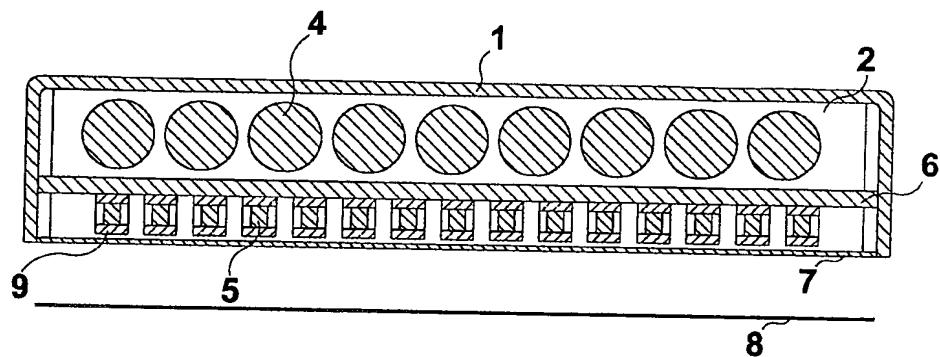


FIG. 1

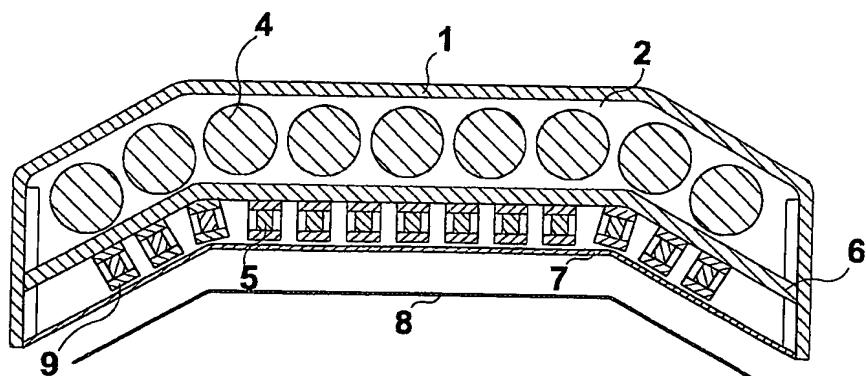
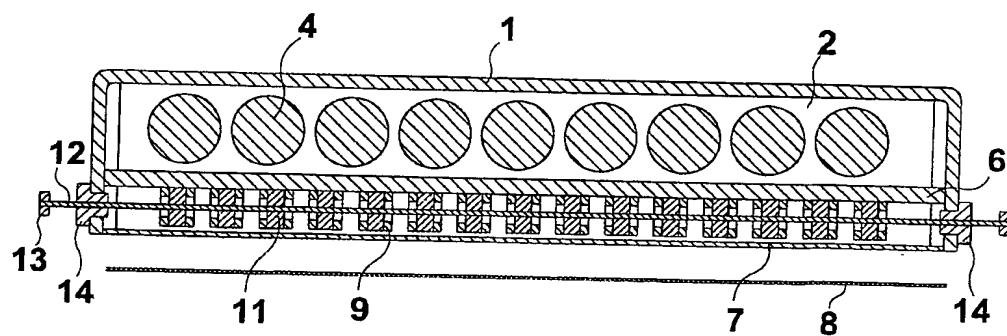
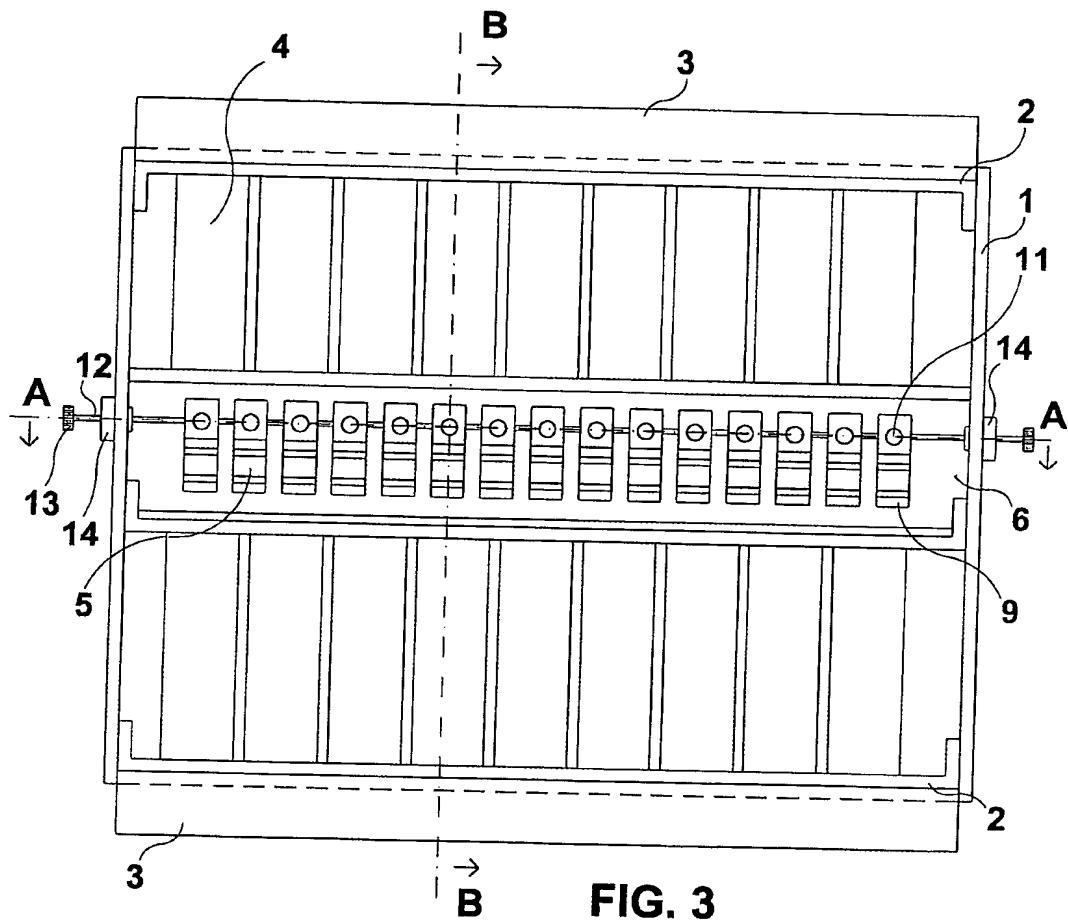


FIG. 2

2/4



3/4

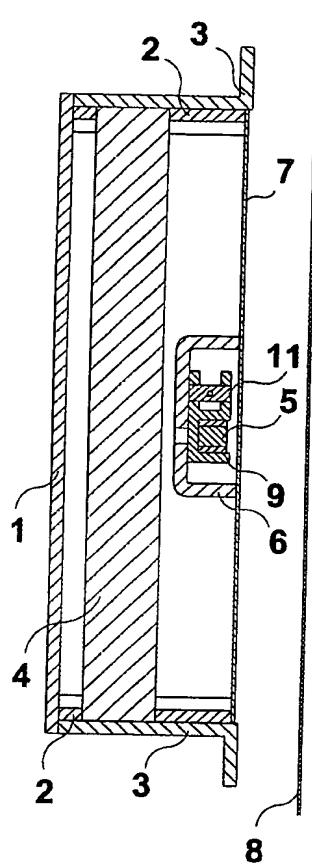


FIG. 5

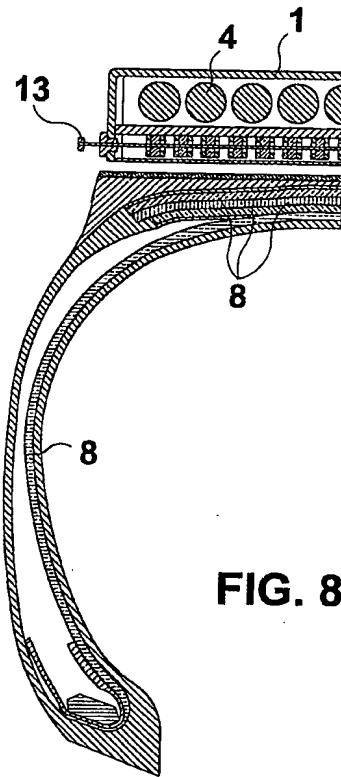


FIG. 8

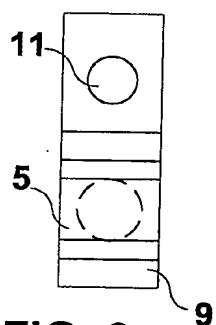


FIG. 6

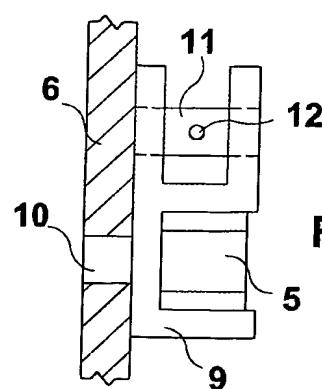
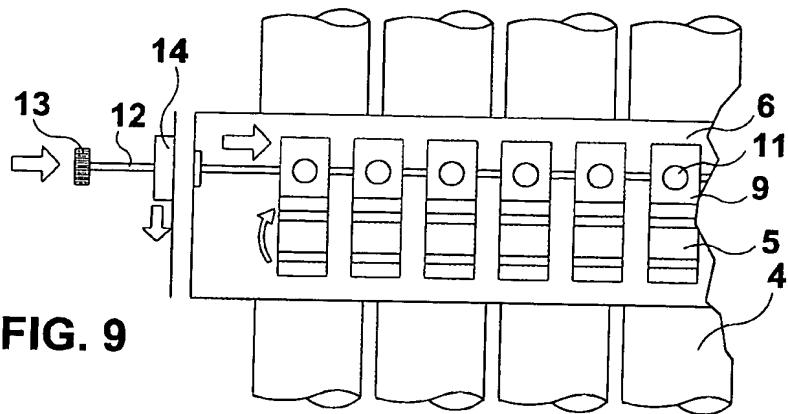
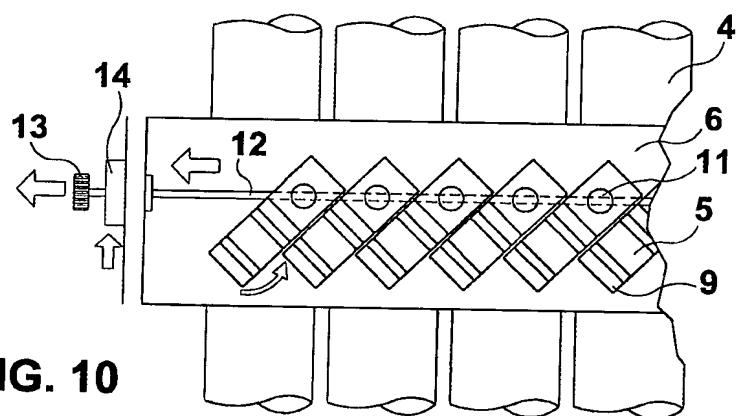
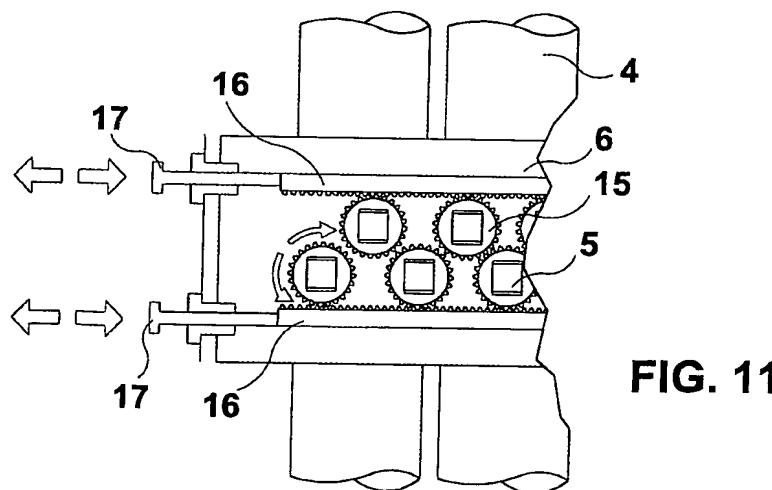


FIG. 7

4/4**FIG. 9****FIG. 10****FIG. 11**

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 02/00804

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01M17/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01M G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2001/019263 A1 (H. KWUM ET AL) 6 September 2001 (2001-09-06) page 4 -page 8 ---	1
Y	US 6 150 809 A (TIERNAN TIMOTHY C ET AL) 21 November 2000 (2000-11-21) column 8 -column 13 ---	1
A	GB 1 270 821 A (LOMA ENGINEERING LTD.) 19 April 1972 (1972-04-19) page 2 -page 4 ---	1-4
A	US 5 221 805 A (LACE MELVIN A) 22 June 1993 (1993-06-22) column 4 -column 10 ---	1-4
	-/-	

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the International filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the International filing date but later than the priority date claimed

- *T* later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *g* document member of the same patent family

Date of the actual completion of the International search	Date of mailing of the International search report
26 August 2003	04/09/2003
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Dietrich, A

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 02/00804

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 901 534 A (SCHULZE KLAUS ET AL) 11 May 1999 (1999-05-11) column 2 -column 3 ---	1
A	EP 0 819 944 A (LUCENT TECHNOLOGIES INC) 21 January 1998 (1998-01-21) column 3 -column 9 ---	1
A	GB 526 805 A (EDWARD LLOYD FRANCIS) 26 September 1940 (1940-09-26) page 3 -page 9 ---	1-4
A	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 04, 2 April 2003 (2003-04-02) & JP 2002 360537 A (MITSUBISHI ELECTRIC CORP), 17 December 2002 (2002-12-17) abstract -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internal PCT/IT	Application No 02/00804
--------------------	----------------------------

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2001019263	A1 06-09-2001	US 6294912 B1 US 2003083289 A1 US 6373245 B1 US 2001017541 A1 US 2002105324 A1 US 2001022514 A1 AU 3875300 A DE 10084592 T0 DK 200101715 A FI 20012186 A JP 2002539449 T WO 0055617 A1	25-09-2001 01-05-2003 16-04-2002 30-08-2001 08-08-2002 20-09-2001 04-10-2000 30-04-2003 16-11-2001 12-11-2001 19-11-2002 21-09-2000
US 6150809	A 21-11-2000	AU 4647897 A WO 9812554 A1	14-04-1998 26-03-1998
GB 1270821	A 19-04-1972	NONE	
US 5221805	A 22-06-1993	US 5422432 A US 5391831 A US 5389731 A US 5391832 A US 5408043 A CA 2053118 A1 DE 69122344 D1 EP 0480432 A2 JP 7072870 A	06-06-1995 21-02-1995 14-02-1995 21-02-1995 18-04-1995 11-04-1992 31-10-1996 15-04-1992 17-03-1995
US 5901534	A 11-05-1999	DE 19620526 A1 FR 2748892 A1	27-11-1997 28-11-1997
EP 0819944	A 21-01-1998	EP 0819944 A1 JP 10073570 A US 5942893 A	21-01-1998 17-03-1998 24-08-1999
GB 526805	A 26-09-1940	NONE	
JP 2002360537	A 17-12-2002	EP 1260827 A2 US 2003011456 A1	27-11-2002 16-01-2003